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### (54) Video camera apparatus

(57) The present invention intends to provide a small video camera apparatus capable of imaging an object from various angles, and effectively monitoring an object or obtaining three-dimensional image information. A light beam supplied from an optical image (A) passing through a lens (111) is picked up by a right image sensing surface of a charge-coupled device (120), and a light beam supplied from an optical image (B) passing through a lens (112) and a prism (113) is picked up by a left image sensing surface of the charge-coupled device (120). The image signals obtained by the right and left image sensing surfaces are divided in a color separating and signal processing circuit (123).

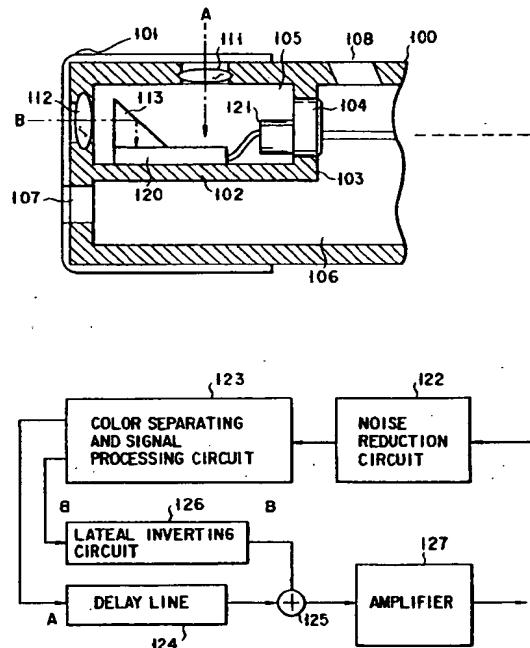


FIG. 1

## Description

This invention relates to a video camera apparatus useful as a monitoring camera, three dimensional camera, endoscopic camera, and so on.

A system comprising a plurality of video cameras is known which is used as a factory monitoring camera system. In this system, the outputs from the plurality of cameras are input to an image synthesizer, and the synthesized image output from the image synthesizer is displayed on the monitor. Known as electronic endoscope cameras are a both front-view type camera and a side-view type camera which type should be used depends on photographing conditions or requirements.

In the conventional monitoring system, a plurality of images photographed by the cameras are simultaneously displayed on one monitor by executing the image synthesizing, or different types of cameras are used separately in accordance with the photographing conditions. Therefore, the conventional monitoring system has to comprise a plurality of cameras in order to simultaneously obtain a plurality of images. Similarly, when images in a plurality of directions are simultaneously required, the conventional electronic endoscope camera cannot provide the desired images.

The object of the present invention is to provide a small video camera apparatus capable of imaging an object from various angles.

Another object of the present invention is to provide a video camera apparatus useful as a monitor for obtaining image information or an apparatus for obtaining three-dimensional image information.

In order to attain these objects, a video camera apparatus according to the invention comprises: a body; first and second optical systems arranged at different positions on the body; a charge-coupled device provided in the body and having image sensing surfaces separated by a black portion, for generating an image signal from light beams supplied from the first and second optical systems, respectively; and dividing means for dividing the image signal representing a first image and a second image signal corresponding to the image sensing surfaces.

The video camera apparatus can generate image information from a plurality of angles by use of the small charge-coupled device formed in the body.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 shows a schematic drawing illustrating one embodiment of the video camera apparatus of the present invention;

FIGS. 2A and 2B show schematic drawings illustrating the operation of the video camera apparatus shown in FIG. 1, and FIG. 2C shows a schematic drawing of the charge-coupled device formed in the video camera apparatus of FIG. 1;

FIG. 3A shows a schematic drawing illustrating a charge-coupled device section of the video camera apparatus of the present invention, and FIG. 3B shows a timing chart of the signals read from the charge-coupled device;

FIG. 4A shows a schematic drawing illustrating another embodiment of the video camera apparatus, FIG. 4B shows a drawing showing an imaging area of the video camera apparatus, and FIG. 4C shows a drawing illustrating an image formed by the video camera apparatus;

FIG. 5 shows a schematic drawing illustrating still another embodiment of the video camera apparatus of the present invention;

FIG. 6 shows a schematic drawing illustrating further another embodiment of the video camera apparatus of the present invention; and

FIG. 7 shows a schematic drawing illustrating another embodiment of the video camera apparatus.

The embodiments of the present invention will be described below with reference to the drawings.

FIG. 1 illustrates one embodiment of the present invention, FIGS. 2A and 2B show, in order to clarify the operation of the apparatus, arrangements of the images formed by use of the apparatus, and FIG. 2C illustrates the structure of the charge-coupled device as a solid state imager.

In FIG. 1, 100 denotes a body as a housing of the camera, for example, formed as a cylindrical shape. One end portion of the body is covered with a protector 101 made of a transparent material. In the body 100, a partition plate 102 is arranged in an axial direction. One end portion of the partition plate 102 is integrated with a rear plate 103 formed to be integrated with an inner wall on one side of the body 100. In the rear plate 103, a round hole is formed such that a bung 104 is attached therewith. The partition plate 102, rear plate 103, and a part of the inner wall of the body 100 form a container section 105. The container section 105 is concealed to prevent the permeation of water.

The side wall of the body 100 forming the container 105 is provided with a lens 111 so as to obtain images on the side of the body. The front wall of the body 100 which also forms the container 105 is provided with a lens 112 so as to obtain images in front of the body. The light beam supplied from an optical image A passing through the lens 111, for example, is picked up by an image sensing surface of the charge-coupled device 120, which is arranged on the right side, for example. Similarly, the light beam supplied from an optical image B through the lens 112 passes through a prism 113 and turns its passing direction and is picked up by an image sensing surface of the charge-coupled device 120, which is arranged on the left side, for example.

FIG. 2A schematically illustrates images A and B read as photoelectrically converted images after the images are picked up by the image sensing surfaces of

the charge-coupled device 120. The image B is laterally inverted (left to right) when the direction in which the light beam passes is turned due to the prism 103.

The photoelectrically converted signal of the charge-coupled device is output to an amplifier 121 and undergone a noise reduction process in a noise reduction circuit 122. The signal undergone the noise reduction process is input to a color separating and signal processing circuit 123 so as to be decoded as a standard video signal. The signal processing circuit 123 has a function for dividing the images A and B by outputting each of the image signals A and B so as to be divided to each other. The dividing process is executed by a method in which, the output signals are divided in the midst of a horizontal scanning, for example, by use of a switch. If the images A and B are parallelly located in a vertical direction, the signals are divided in the midst of a vertical scanning by use of the switch.

The image signal of the image A is supplied to a synthesizer 125 through a delay line 124. While, the image signal of the image B is input to an image inverting circuit 126 to be laterally inverted and then supplied to the synthesizer 125. The synthesizer 125 synthesizes the image signal of the image B output from the image inverting circuit 126 and the image signal of the image A output from the color separating and signal processing circuit 123, and converts the time-multiplied signal into a video signal to be displayed as one synthesized image. The output of the synthesizer 125 is supplied to a monitor 130 through the amplifier 127. In this manner, the images A and B are displayed on the monitor 130 so as not to be inverted, as shown in FIG. 2B. The inverting process of the image inverting circuit 126 is executed for inverting the time axis of the horizontal scanning of the image signals by using a memory device. Due to this process of the image circuit 126, the time delay occurs in the signal propagation of the image B. In order to make the image signal for the image A arrive at the same time as the image signal of the image B, the image signal of the image A is delayed by the delay line 124 before the signal is input to the synthesizer 125.

In a conventional charge-coupled device, an optical black portion 140 shown in FIG. 2C is arranged on one end portion of the horizontal scanning in order to prevent the influence of a dark current. In addition to the optical black portion, the charge-coupled device 120 of the present invention is supplied with an image separating black portion 141 for shielding light in the midst of the device. The image separating black portion 141 is formed by use of a photolithography or painting method to apply an aluminum layer on a transparent protective film as an insulating layer formed on a sensing section of the charge-coupled device.

If the video camera of this embodiment is intended to obtain both the image A in front of the body and the image B located above or below the body, the above-mentioned lateral image inverting process is replaced with a vertical image inverting process.

In addition, the influence of the image separating black portion 141 on the charge-coupled device 120 is emerged as a black belt-like zone in the central portion of the display when the output of the charge-coupled device 120 is displayed without any processing. This influence can be removed from the displayed image by changing the period of time set for reading a signal from the lateral inverting circuit 126 or adjusting the delay time of the delay line 124.

FIG. 3A presents a sectional view illustrating a specific constitution of the charged-coupled device 120. On the charge-coupled device, integrated shielding members 151, 152, and 153 are arranged immediately on the optical black portion 140, the image separating black portion 141, and a starting point of the horizontal line, respectively. In particular, the shielding member 152 is provided to shield the light beams passing through the space between left and right image areas in order to prevent the interference between the light beams supplied from the image areas. The shielding members 151, 152, and 153 are also used as a spacer for connecting the prism 113, a protective glass layer 114, and the charge-coupled device 120 to each other.

FIG. 3B shows a timing chart for comparing a signal S1 generated by the charge-coupled device 120 of the present invention and a signal S2 generated by the conventional charge-coupled device. The timing chart clearly shows that, according to the charge-coupled device 120 of the present invention, image signals of two images can be obtained even in accordance with the conventional image reading process.

The above-mentioned embodiment relates to an example for imaging objects located in two directions. The present invention, however, is not limited to the above embodiment.

FIG. 1 will be described again.

In the body 100 of FIG. 1, there is a space on the opposite side of the container section 105 with regard to the partition plate 102, i.e., under the container section 105. In the front of the space 106, a through hole 107 is provided. This hole can be used as a hole in which a lighting device for lighting the front of the body, or a forceps used for a surgical operation or the like is fitted. In FIG. 1, only one through hole 107 is illustrated, but a plurality of holes are provided to the apparatus, in fact. Similarly, the side wall of the body 100 is also provided with a through hole 108 for providing a lighting.

The video camera apparatus shown in FIG. 1 effectively works as a medical camera. For example, when a stomach is monitored by use of this camera, the images of the portions located in front and on the side of the camera can be simultaneously obtained without turning the camera.

In the signal processing of the video camera of the present invention, the color separating and signal processing circuit 123 executes a color signal generating process, then executes a separation of the images. In the signal processing, the color signal generating process is executed at first so as not to prevent the color syn-

chronization. If the separation of the images were executed at first, the original color of the images could not be precisely reproduced.

In FIG. 1, the body is defined as a cylindrical shape. However, the body may be formed as an oval, or triangle or square pole. The charge-coupled device 120 is described as a color charge-coupled device having color filters, but may be a monochrome charge-coupled device, of course. The body may be also formed with a transparent material so as to be integrated with the lenses.

Further, when the body 100 contains the noise reduction circuit 122, color separating and signal processing circuit 123, image inverting circuit 126, delay line 124, synthesizer 125, and amplifier 127, the body 100 is formed as a fixing structure to be sufficiently waterproofed and to resist the shaking. In the embodiment, these elements are integrated contained in the body 100, but may be formed out of the body 100 at a distance. Similarly, the outputs from the image inverting circuit 126 and the delay line 124 are synthesized by the synthesizer 125, but may be input to different monitors respectively.

FIG. 4A shows another embodiment of the present invention.

As shown in FIG. 4A, the apparatus of this embodiment is provided with first, second, and third lenses 201, 202, and 203. The first lens 201 gets a ray from the object and an image passes through a protective glass layer 211 and is picked up by an image sensing surface 301 located in a midst of a charge-coupled device 300. Similarly, the second lens 202 gets a light beam supplied from the object located on the left side and the light beam supplied from the image passes through a prism 212 and is picked up by an image sensing surface 302 located in the left side of a charge-coupled device 300. The third lens 203 also gets a light beam from the object and an image passes through a prism 213 and is picked up by an image sensing surface 303 located in the right side of a charge-coupled device 300. In FIG. 4A, reference numbers 351, 352, 353, and 354 denote shielding members for optically separating the image sensing surfaces from each other. Immediately under the shielding members 351, 352, 353, and 354, image separation black portions 361, 362, 363 and 364 are formed in the charge-coupled device 300.

By virtue of this structure, the video camera apparatus can be formed as a wide-angle camera which has an imaging area of 270° as shown in FIG. 4B and will not cause so large optical distortion. According to this camera, front, left, and right images can be displayed on the monitor as shown in FIG. 4C.

This video camera apparatus effectively works as a monitoring camera. If this camera is equipped in a car, the driver can easily monitor the front, left, and right directions. The camera can be set up in rear of a car to effectively monitor the backward, left and right.

The present invention is not limited to the above-mentioned embodiments, but can be used as a three-dimensional video camera.

FIG. 5 presents an example of a three-dimensional video camera.

A body 500 is provided with left and right imaging lenses 5L and 5R each having a convergence angle. The light beam supplied from optical images AL and AR pass through the lenses 5L and 5R and arrive at the left and right portions of the image sensing surface of the charge-coupled device 520 through prisms (or reflecting mirrors) 51L and 51R. Image signals generated by the charge-coupled device 520 are input into an image dividing circuit 522 through an amplifier 521 and divided into left and right image signals. The user can obtain a three-dimensional image on the basis of the left and right images by a method using a peephole or glasses.

FIG. 6 shows still another embodiment of the present invention.

In this embodiment, charge-coupled devices 120R and 120L are coupled back to back with an adhesive and arranged to hold a central axis of a body 600 therebetween. Lenses 111R and 111L are arranged oppositely to the rear portions of image sensing areas of the charge-coupled devices 120R and 120L. The lenses 111R and 111L are fixed to the side walls of the body 600. The front portions of the image sensing areas of the charge-coupled devices 120R and 120L are provided with prisms 113R and 113L respectively so as to be integrally formed therewith. The prisms 113R and 113L respectively receive the optical images passing through lenses 112R and 112L. The lenses 112R and 112L are set in and fixed in holes in a front wall of the body 600.

The front edges and the side edges of the charge-coupled devices 120R and 120L are supported by a supporting member 611 formed in the body 600, and the rear edges of the charge-coupled devices 120R and 120L are supported by a fixing member 621. The fixing member 621 has guiding portions for guiding wirings connected to the charge-coupled devices 120R and 120L.

According to the video camera apparatus of this embodiment, the images of the front and left and right sides of the object can be obtained, and thus the imaging area can be enhanced. How to process and display the imaging signals is determined by a video signal processing circuit for dividing the imaging signals.

In the above embodiment, the supporting member 611 is arranged in the body 600. The supporting member 611, however, can be also formed as the rotation axis of a body 600 arranged in the center of the body 600. In this case, the charge-coupled devices 120R and 120L and prisms 113R and 113L are integrated and rotatably arranged in the body. The integrated element is called as a imaging unit. In this structure, lenses having a magnification different from the lenses 111R and 111L may be provided on the circumference of a circle of the section of the body, on which the lenses 111R and 111L are arranged. By providing the lenses with different magnifications in this manner, the user can select a most suitable lens to obtain an image of the object in accordance with the distance between the body and object.

As described above, according to the present invention, a small video camera apparatus capable of imaging an object from various angles, and effectively obtaining three-dimensional image information, can be obtained.

FIG. 7 shows another embodiment of the present invention.

In this embodiment, the protector 101 has a plurality of converting lenses 115, 116, 117, . . . (116, 117 are not shown) on the circumference, and the protector 101 can rotate on the body 100, then one of converting lenses is selectively corresponded to the lens 111. According to this embodiment, different magnification images are obtained by switching the converting lenses. Since another portions are same with the embodiment shown FIG. 1, the explanation of those portions is abridged.

### Claims

1. A video camera apparatus comprising:  
a body (100);  
first and second optical systems (111, 112, 113, 202, 203) arranged at different positions on the body (100);  
a charge-coupled device (120, 300) provided in the body and having image sensing surfaces separated by a black portion, for generating an image signal from light beams supplied from the first and second optical systems, respectively; and  
dividing means (123) for dividing the image signal representing a first image and a second image signal corresponding to said image sensing surfaces.
2. A video camera apparatus according to claim 1, characterized in that at least one of the first and second optical systems is integrated with one of the image sensing surfaces.
3. A video camera apparatus according to claim 1, characterized in that the image sensing surfaces of the charge-coupled device are in parallel with an axis of the body.
4. A video camera apparatus according to claim 1, characterized in that the second optical system (112, 113) guides a light beam supplied from an optical image to one of the image sensing surfaces through a reflection member, and the first optical system (111) guides a light beam supplied from an optical image directly to another one of the image sensing surface.
5. A video camera apparatus according to claim 1, characterized in that the first and second optical systems (202, 203) respectively guide light beams supplied from optical images to the image sensing surfaces of the charge-coupled device (300) through reflection member (212, 213).

6. A video camera apparatus according to claim 1, characterized by further comprising a lateral image inverting circuit (126) for inverting a time-axis of a horizontal scanning of one of the signals divided by the image signal dividing means (123).
7. A video camera apparatus according to claim 6, characterized by further comprising converting means (125) for time-multiplying a second image signal output from the lateral image inverting circuit (126) and said one of the signals divided by the image signal dividing means so as to convert the image signals into one video signal.
8. A video camera apparatus comprising:  
a charge-coupled device (300) formed in the body;  
first optical system (202) for guiding a light beam supplied from a first optical image to a first image sensing surface of the charge-coupled device through a first reflection member (212);  
second optical system (203) for guiding a light beam supplied from a second optical image to a second image sensing surface of the charge-coupled device through a second reflection member (213); and  
third optical system (201) for guiding a light beam supplied from a third optical image directly to a third image sensing surface of the charge-coupled device.

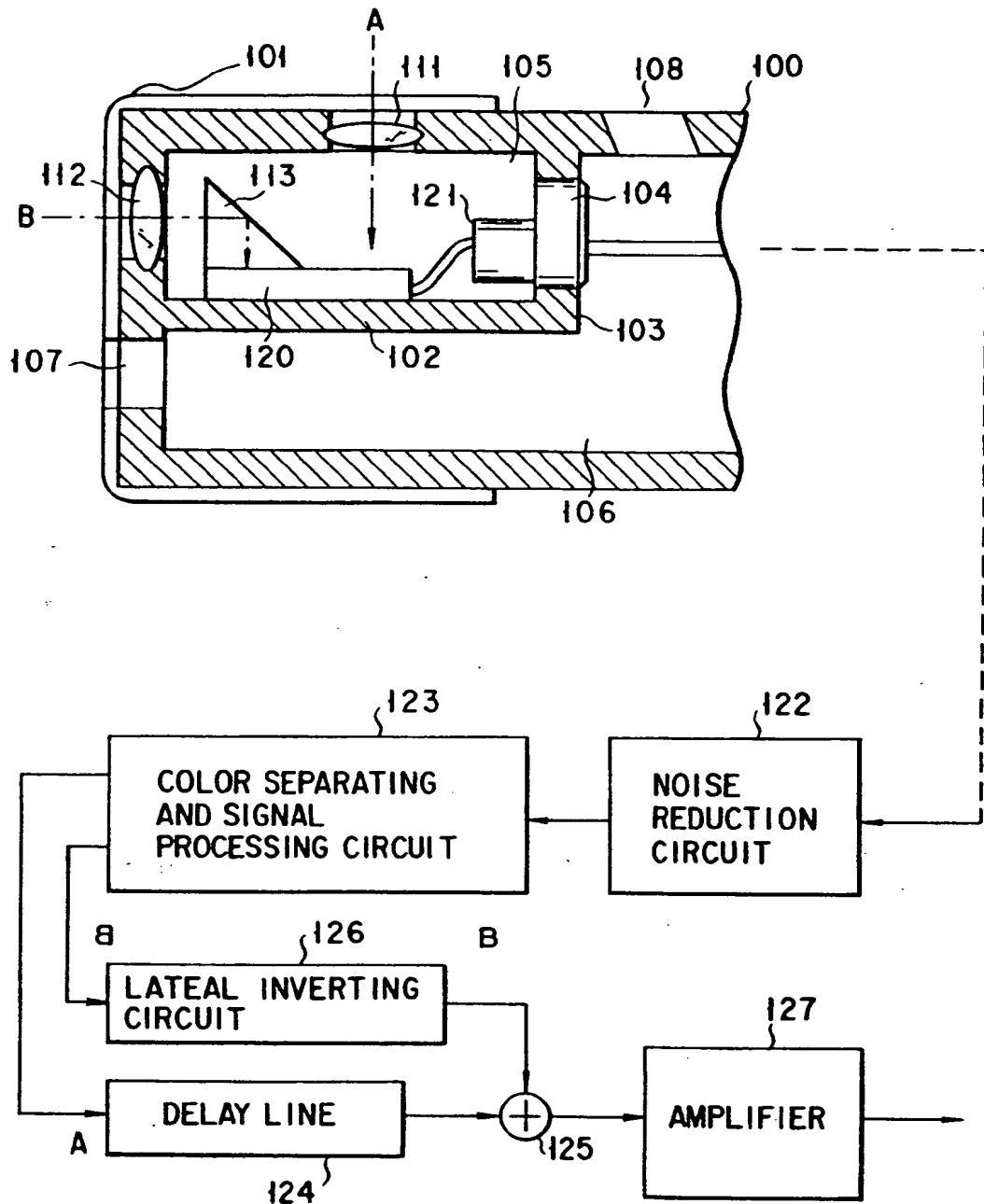
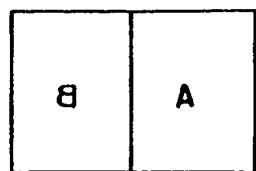
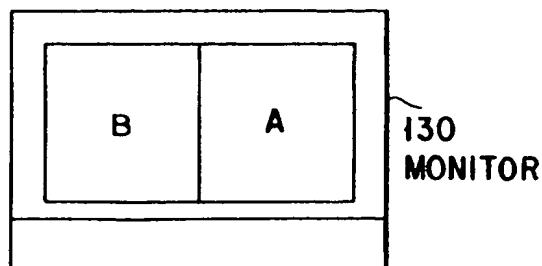


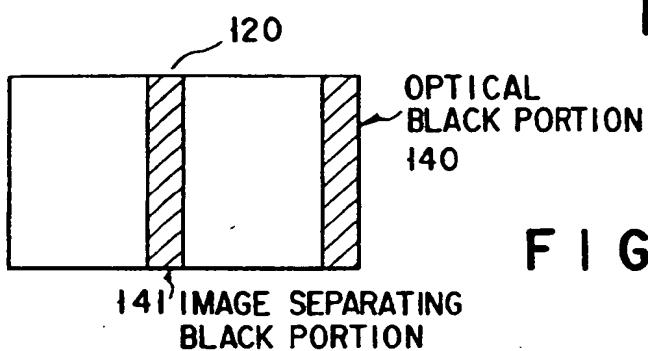
FIG. 1



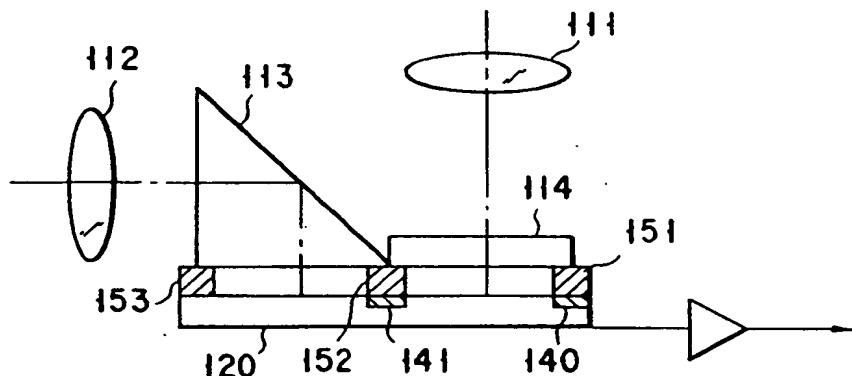
F I G. 2A



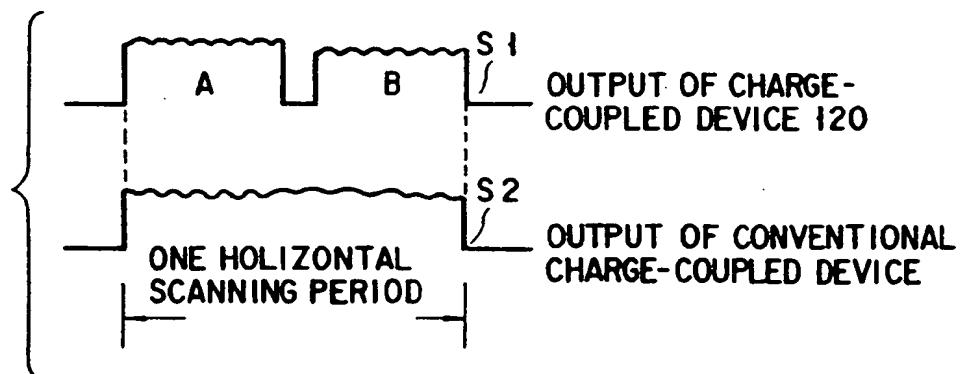
F I G. 2B



F I G. 2C



F I G. 3A



F I G. 3B

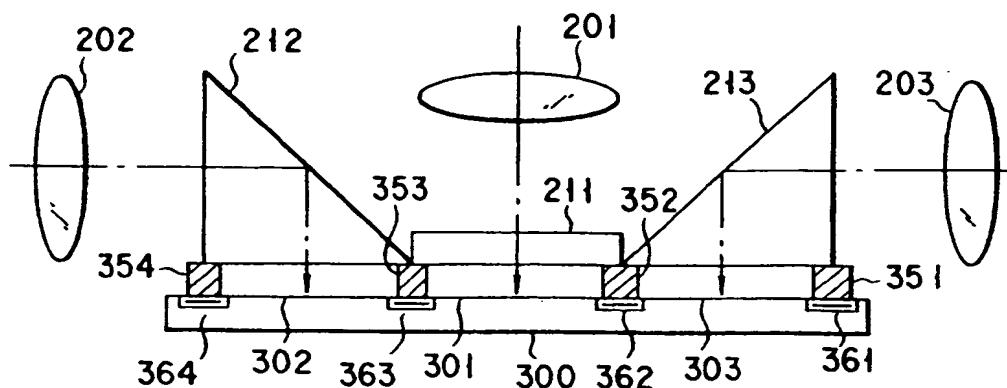


FIG. 4A

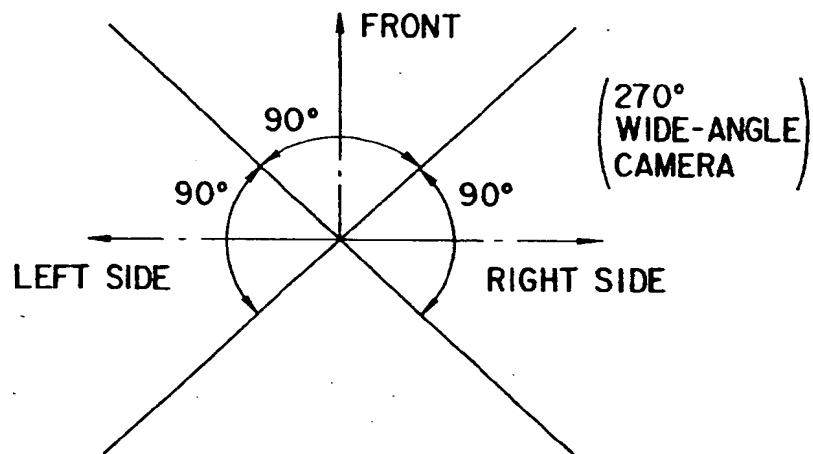


FIG. 4B

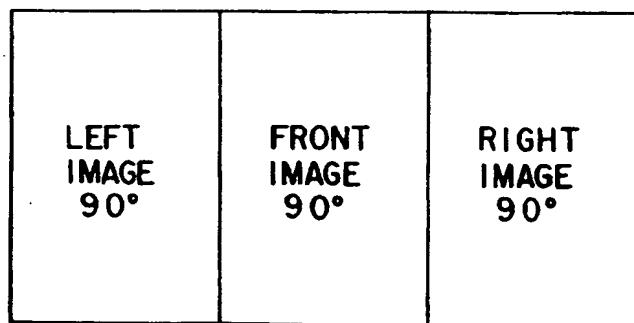
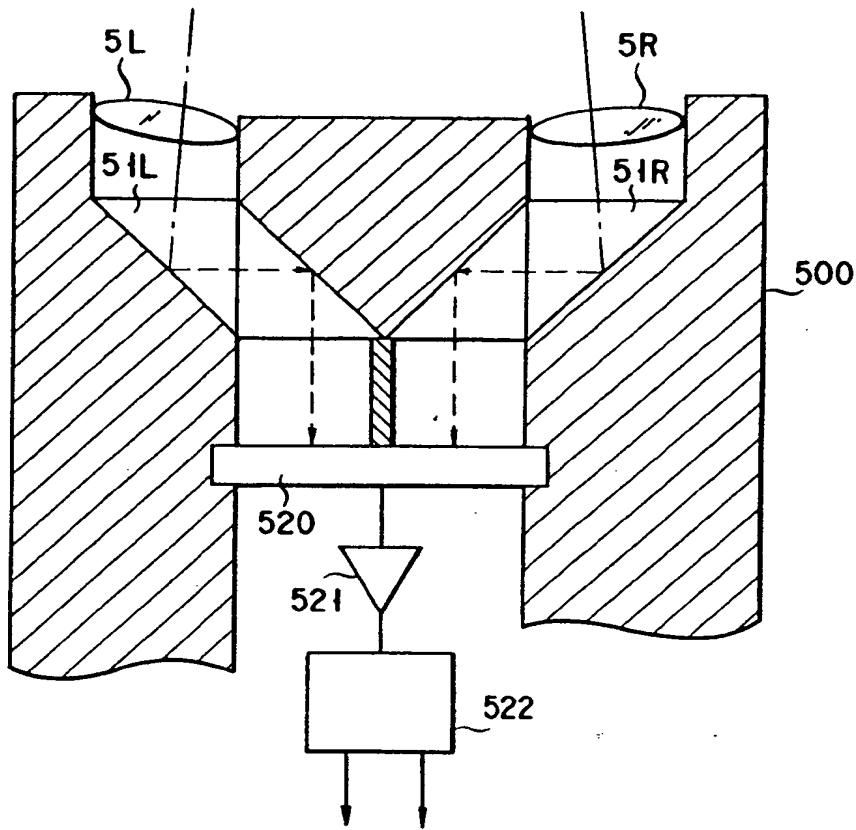
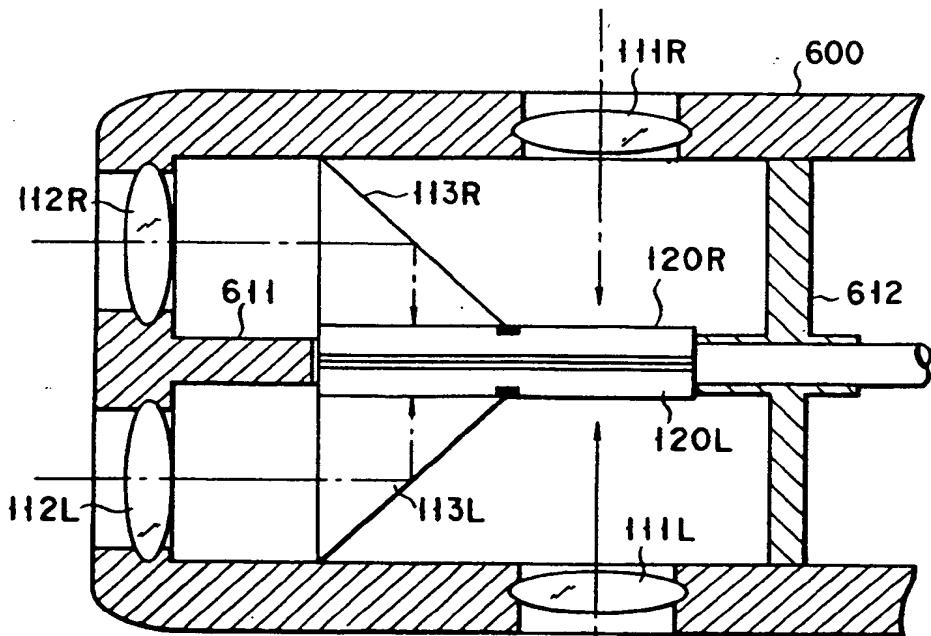


FIG. 4C



F I G. 5



F I G. 6

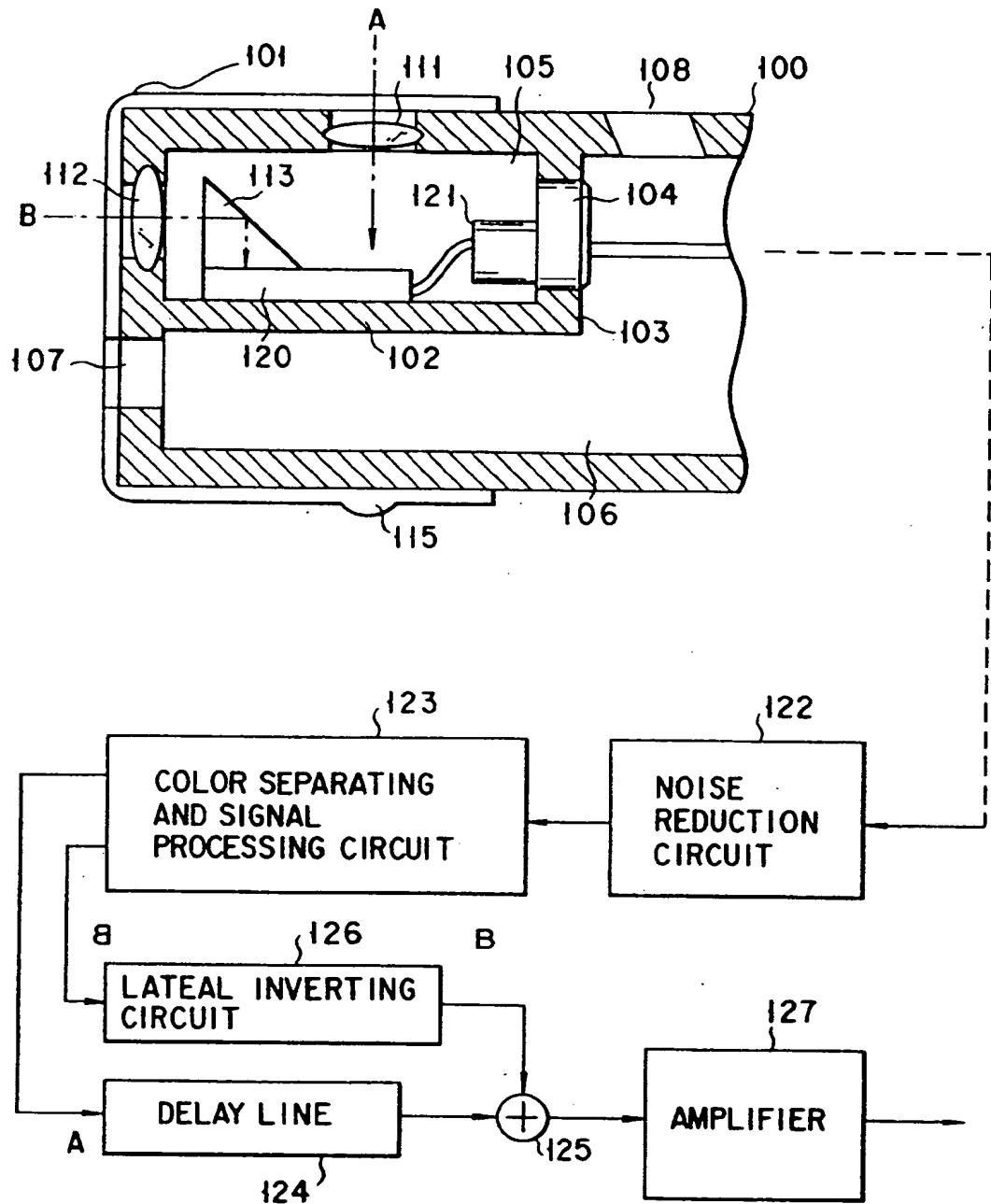


FIG. 7

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### (54) Video camera apparatus

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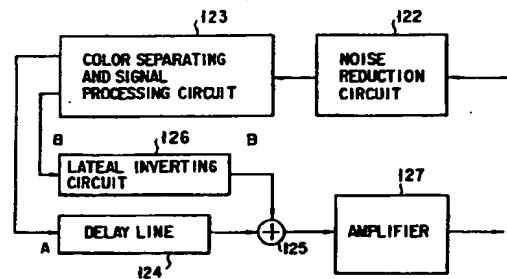
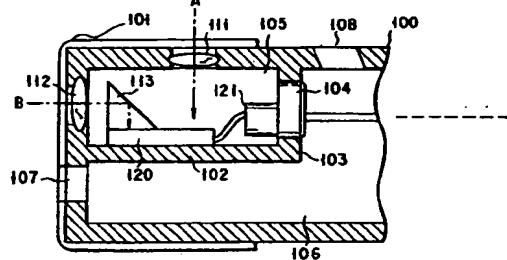


FIG. 1

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## EUROPEAN SEARCH REPORT

Application Number  
EP 95 11 6819

| DOCUMENTS CONSIDERED TO BE RELEVANT  |  |  |   |
|--|--|--|---|
| Category   | Citation of document with indication, where appropriate, of relevant passages  | Relevant to claim  | CLASSIFICATION OF THE APPLICATION (Int.Cl.6)    |
| X  | WO-A-93 11631 (VLSI VISION LTD) 10 June 1993   | 1-3  | H04N13/02<br>H04N3/15                           |
| Y  | * page 2, line 11 - line 15; figures 1,4,5<br>*  | 5  | H04N13/00<br>H04N5/225                          |
| X  | US-A-4 167 756 (SMITH WILLIAM V) 11 September 1979   | 8  |   |
| A  | * column 1, line 31 - line 44 *<br>* column 2, line 47 - line 55; figures 3,4<br>*                                     | 4  |   |
| Y  | ---  |  |   |
| Y  | WO-A-93 21736 (CROMWELL MARKETING CO INC) 28 October 1993<br>* page 2, line 29 - page 3, line 12;<br>figures 1,18,19 * | 5  |   |
| A  | DE-A-38 06 190 (OLYMPUS OPTICAL CO) 8 September 1988<br>---  |  |   |
| A  | FR-A-1 442 335 (M.A. ROUX) 2 September 1966<br>---   |  |   |
| A  | GB-A-2 240 444 (PHILIPS ELECTRONIC ASSOCIATED) 31 July 1991<br>-----   |  | TECHNICAL FIELDS<br>SEARCHED (Int.Cl.6)<br>H04N |
| <p>The present search report has been drawn up for all claims</p>  |  |  |   |
| Place of search  | Date of completion of the search   | Examiner   |   |
| THE HAGUE  | 13 September 1996  | Montanari, M   |   |
| CATEGORY OF CITED DOCUMENTS  |  | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or<br>after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding<br>document |   |
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